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RESEARCH ARTICLE

Assessment of Different Seed Enhancement Techniques on Seed Viability and Storability Potential of Pigeon Pea (*Cajanus cajan millsp*) Genotypes

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ABSTRACT: Rapid germination is very important for better plant growth and development under stress condition. Presence of hard seed coats, seed borne pathogens and unfavorable environmental condition hinder the normal seedling establishment in legumes. Earlier seed enhancement is mainly achieved through synthetic and plant growth regulators which are not environmental friendly. To evaluate the efficacy of different seed enhancement techniques on seed viability and storability potential of pigeon pea genotypes, an experiment was conducted in Crop Science Department of the University of Agriculture and Environmental Science Umuagwo, Owerri, Nigeria. Treatments in the experiment comprised of seeds of the ten freshly harvested pigeon pea genotypes, treated with five seed enhancement formulations consisting of three organic materials (scent leaf powder, Red chili fruit powder, Ginger powder), inorganic materials (Aspirin tablet and bleaching powders) and a control. Priming with the selected organic and inorganic materials enhanced the quality parameters compared to untreated control. Aspirin tablet powders and red chili fruit had better viability and vigor performance on pigeon pea seeds than other treatments. The two treatments maintained 70% seed viability even after 360 day of storage. Thus, aspirin tablet powders and red chili fruit are recommended for use by small and medium scale seed dealers and farmers especially where modified seed conditioning is far beyond reach and unaffordable.

KEYWORDS: Organic priming, Pigeon pea, seed priming, Synthetic materials, Seed viability

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1. INTRODUCTION

Pulse is one of the best plant protein sources and is an important part of the diet of ordinary people in developing countries such as Nigeria. Legumes play an important role in Nigerian nutrition because their edible seeds provide a low-cost source of protein. Food legumes have been dubbed "poor man's meat," owing to the fact that animal protein sources are rarely affordable to the majority of the population [1]. Minor pulses are grown on a small scale by economically disadvantaged farming communities for subsistence food. These crops are currently underutilized or ignored, despite the fact that they are good sources of protein and can help increase food security in rural areas. Pigeon peas are the fifth most produced crop in the world and the second most important legume after beans CAB International., [2]. The most significant of all pigeon pea usage in semi-arid and tropics is the high protein content of the seeds. Main pigeon pea producing regions are the Indian sub-continent, Central America and Southern and Eastern Africa CAB International [2]. According to Bekele [3] pigeon pea (*Cajanuscajan* (L.) Huth) is the most prevalent fast-growing and adaptable pulse crop especially in the tropical and subtropical climates. Pigeon pea is beneficial to food and animal feed in a variety of ways.

Seed priming according to Ehsanfar *et al.*,[4] defined it as a technique which improves the germination and early growth under prevailing environmental conditions. Butler *et al.*,[5] in his

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work, reported that seed priming has the tendencies to repair damaged aged seeds or seeds exposed to abiotic stresses such as salinity and improve germination performance. Seed priming is a technique that can be applied to improve germination and growth of seeds in heavy metal-contaminated areas or in adverse agro-climatic conditions. This help in uniform seed emergence which ultimately, optimize harvesting efficiency resulting in potential yield increase. Several scientists have reported the efficacy of seed priming being used successfully to improve seed germination and seedling emergence of many crops especially vegetables, legumes and small seeded grasses. Seed priming has presented promising, and even surprising result, for many seed including the legume seeds. According to Soeda *et al.,*[6], improvement in priming can be affected by some factors such as plant species; priming factor (water potentials), priming duration, temperature, vigour and seed primed storage condition.

In hydro-priming method, germination process is induced by soaking seeds in water or in solutions containing exogenous molecules such as salts metals or hormones [7], but then halted by drying of the seeds. Khan et al., [7] established from his work that primed seeds tend to show better germination and growth even when imposed to stressful conditions. However, most commonly used priming strategy to improve seed germination in stressful conditions is hormone pre-treatment Jisha *et al*., [8], Hu *et al*.,[9]. For example, seeds of rye (*Secalemontanum*) pretreated with gibberellic acid (GA3) increased germination in water deficit conditions 10]. In pepper (*Capscum annum* L.), Khan *et al*., [7] showed that pretreatment with acetylsalicylic acid and salicylic acid resulted in greater uniformity of germination and establishment of seedlings under high salinity. In the recent year, the use of local botanicals has gained much attention. Organic seed priming has several advantages among which are ; cost effectiveness to farmers, time saving, and most of all , environmental friendly to both human, animal and entire ecosystem [11]. Balasubramanyam and Eeshwari [12] reported the use of Panchagavya, Beejamrutha and botanicals to effectively control bacterial isolated Sclerotium. Hu *et al.,*[9], reported Beejamrutha as an organic product, that contain beneficial microorganisms predominantly lactic acid bacteria, yeast, actinomycetes, photosynthetic bacteria, nitrogen fixers, phosphorus solubilises and fungi. Also, Yong et al., [13] used Coconut water, obtained from drupe of *Cocosnucifera* to exhibit a wide range of active growth regulatory activities. According to Jisha, *et al.,*[8] the leaf extract of moringa was reported to promote natural plant growth enhancer while that of Sea weeds was reported to contain multiple growth regulators. Divij *et al.*, [14] reported that Priming with the selected organics and botanicals was found to enhance the quality parameters in pigeon pea seeds. Larissa *et al*.,[15] reported the use of hormonal priming in the improvement of pigeon pea germination against heavy-metal tolerance. However, the resultant effects of all the above techniques used were targeted for seed improvement of germination speed, germination vigor, seedling establishment, uniformity and yield. Several researches on the efficacy of seed enhancement techniques had been conducted but most of this research focused on the use of synthetics and growth regulators which are not environmental friendly while the use of botanicals especially, those within reach has been given little attention in most of the researches. Sequel to the above, assessment of different seed enhancement techniques on seed viability and storability potential of pigeon pea genotypes was evaluated.

2. MATERIALS AND METHODS

2.1.1 Seed material and preparation

The seeds used for the study was obtained from Obafemi Awolowo University, Institute of Agricultural Research and Training, moore plantation, Ibadan. Freshly harvested 10 pigeon pea genotypes from 2020 and 2021 cropping years were utilized for the study. Seeds extracted from the freshly harvested pods were cleaned, sorted and tested for seed moisture content (9-11%) under ambient temperature using John Wilkey moisture tester apparatus and kept in aluminum foil bottle before seed quality assessment were conducted.

2.1.2 Seed enhancement procedure

Seeds of the ten freshly harvested pigeon pea genotypes were treated with five seed enhancement treatments consisting of three organic materials (scent leaf powder, Red chili fruit powder, Ginger powder), two inorganic materials (Aspirin tablet and bleaching powders) and a control (Table 1).

2.1.3 Method of seed treatment

A 300g seed of each ten genotypes was placed in plastic bottles (1.5ltr) and respective doses of each treatment were added in each cropping years and mixed thoroughly for 3 minutes in 2 days to allow uniform mixing of treatment with seeds. A 100g of each treated seeds of pigeon pea genotype was then placed inside plastic containers of 0.5ltr capacity and then tightly covered with lids. The packaged treated seed lot of each genotype was kept in Crop science laboratory of the University of Agriculture and Environmental Science, Umuagwo, Owerri, Nigeria under ambient conditions until usage. The trial was a factorial experiment in a complete randomized design with three replicates. Treated seed samples were taken from each plastic container for seed quality assessment at 120, 240 and 360 days after storage.

2.1.4. Seed viability test

Seed viability test was used to determine the viability of seeds. Three sub samples of 100seeds were placed on moistened paper towel with 10mls of distilled water inside petri-dishes and germinated at 25^{o}C in an incubator (capacity 100ltrs) at the laboratory of Crop science Department, in University of Agriculture and Environmental Science Umuagwo. Germination count for normal seedling at 8days after sowing was expressed as percentage of viable seeds for each genotype.

2.1.5 Data analyses

All data collected were subjected to a statistical analysis system using the statistical software (SAS™, 2017). The treatment means were separated using the least significant differences at a 5% level of probability.

Table 1: Seed enhancement treatments, recommended rate and their active ingredients

Treatment	Recommended rate	Active ingredient
Organic		
scent leaf powder	10g/100g of seeds	Linalool
Red chili fruit powder	10g/100g of seeds	Capsicin
Ginger powder	10g/100g of seeds	Gingerol
Inorganic		
Bleaching powder	2 g/ kg of seed	Calcium hydrochloride (30%)
Aspirin tablet powder	100g/kg of seed	Ortho-acethylicyclic (56.5%)
Control		

3. RESULTS

Mean square values for seed viability value of 10 pigeon pea genotypes after treatment under different storage periods are presented in Table 2. Genotype and seed treatments had highly significant (P<0.01) effect under each storage time evaluated. The interaction effect of genotype x seed treatment (GXS) was also highly significant (P<0.01) at each of the storage duration. Effect of storage duration on viability of ten pigeon pea genotypes across seed enhancements is presented in Table 3. The findings revealed differential responses in seed viability values among genotypes at each storage time. The result showed that at 0 days of storage, NSWCC-34 seed recorded the highest viability (92.0%) closely followed by NSWCC-19 with (90.0%) while NSWCC-29b had the least value of 51.0%. After 120 days of storage, NSWCC-19 and NSWCC-34c seeds recorded highest values of 79.0 and 78.0 %, respectively, whereasNSWCC-29b had the least viability (40.0%.). After 240 days of storage, NSWCC-19 (62.0%) and NSWCC-18 (56.0%) retained highest viability, while the least values of 33.0 and 35.0 % were obtained in NSWCC-18b and NSWCC-34b, respectively. There was sharp decline in viability seeds stored for 360days while NSWCC-34c and NSWCC-19 maintained the highest (53.0%) and (49.0%) viability respectively, with NSWCC-18b and NSWCC-34b had the least values of 21 and 22%, respectively. The effect of seed enhancement on percentage seed viability of ten pigeon pea genotypes under different storage duration is presented in Table 4. At the onset of the storage, the seeds were not statically different from one another, in respect to their viability. The percentage viability ranged between 75.0- 76.0%. However, at 120 days of storage, seed viability of pigeon pea seeds treated with powdered scent leaf (65%) were not significantly different from seeds treated with ginger fruit (65%) powdered or red chili pepper fruit powder (64%). The untreated seeds (control) recorded significantly least (62.0%) viability. Similar observation was recorded at 240 and 360days of storage. Although, the percentage seed viability of the pigeon pea decreased with increase in duration of storage seeds treated with powder of scent leaf, red chili pepper performed better than other treatments. Red chili pepper fruit powder (64%) and Aspirin powder (42%) had the highest viability while untreated seed had the least with 33.0 % viability.

Tables 2: Mean square values for seed viability data of 10 pigeon pea genotypes after treatment under different storage periods

Source of variance	DF	Days of storage			
		0	120	240	360
Replicate(R)	2	2.14^{ns}	2.28^{ns}	7.50^{ns}	3.21^{ns}
Genotype (G)	9	333.44**	3196.12**	2697.37**	3187.01*
Seed Enhancement (s)	5	11.87**	25.57**	121.78*	374.47**
GXS	45	3.47**	6.98**	17.978**	200.96**
Error	119	2.01	2.41	6.45	8.0

**-significant at 1% probability level
*- significant at 5% probability level
ns- Not significant

Table 3: Effect of storage duration on viability of ten pigeon pea genotypes across seed enhancements

Genotype	Days of storage			
	0	120	240	360
NSWCC-18	80^{c}	71^{b}	56^{b}	44^{c}
NSWCC-18b	60^{f}	46^{f}	33^{f}	21^{g}
NSWCC-19	90^{b}	79^{a}	62^{a}	49^{b}
NSWCC-28	70^{d}	60^{c}	47^{d}	35^{e}
NSWCC-29b	51^{h}	40^{g}	28^{g}	16^{h}
NSWCC-32	78^{c}	65^{c}	53^{c}	39^{d}
NSWCC-34	70^{d}	59^{c}	47^{d}	38^{d}
NSWCC-34c	92^{a}	78^{a}	53^{c}	53^{a}
NSWCC-34b	58^{g}	49^{e}	35^{f}	22^{g}
NSWCC-35	64^{e}	51^{d}	40c	25^{f}

Table 4 Effect of seed enhancement on percentage seed viability of ten pigeon pea genotypes under different storage duration

Seed treatment	Days of Storage			
	0	120	240	360
Scent leaf powder	75^{ab}	65^{a}	52^{a}	40^{b}
Red chili fruit powder	75^{ab}	64^{ab}	52^{a}	43^{a}
Ginger fruit powder	75^{ab}	65^{a}	51^{ab}	38^{c}
Bleaching powder	75^{ab}	63^{b}	50^{b}	38^{b}
Aspirin powder	76^{a}	63^{b}	50^{b}	42^{ab}
No treatment	76^{a}	62^{c}	46^{c}	33^{d}
S.E	0.28	0.30	0.49	0.54

Mean followed by the same alphabet along same column are not significantly different from one another at 5% probability.

Effect of seed enhancement material on seed viability of ten pigeon pea genotypes at 240 days of storage is presented in Table 5. The result showed that scent leaf powder treated seed lot of NSWCC-34c and NSWCC-19 had highest viability values of 72 and 71%, respectively followed by NSWCC-32(68.0%) while NSWCC-18b recorded lowest value of 44.0%. For red chili powder treatment, seeds of NSWCC-34c, NSWCC-19 and NSWCC-18 recorded highest values of between 75.0, 73.0 and 72%, respectively but NSWCC-18b had the least viability value of 42.0%. With ginger powder treated seeds, NSWCC-19 (76.0%) and NSWCC-34c (73.0%) had highest viability while NSWCC-18b still maintained lowest values of 45.0%. Furthermore, bleaching powder treated seeds of NSWCC-34c (75.0%) recorded highest viability value followed by NSWCC-19 (70.0%), NSWCC-18 (69.0%) while NSWCC-29b (39.0%) also recorded the lowest viability at the storage time evaluated. For aspirin tablet powder treatment, NSWCC-34c (75.0%) and NSWCC-19 (73.0%) obtained highest viability but lowest viability was recorded with NSWCC-29b (39.0%) and NSWCC-18b with (44%). With no treatment seeds, highest viability was recorded with NSWCC-19 (70.0%) followed by with NSWCC-34c (66.0%) while the lowest viability was recorded with NSWCC-18b (42.0%).

Effect of seed enhancement material on seed viability of ten pigeon pea genotypes at 360 days of storage is presented in Table 6. The table showed that seed of NSWCC-34c treated with scent leaf powder had highest viability of 65.0% followed by NSWCC-19 with 43%. All other genotypes had seed viability of less than 40% except NSWCC-18 and NSWCC-32 with 42.0 and 40 %, respectively. With red chili fruit pepper powder treatment, seed of NSWCC-34c had viability of 72.0% followed by NSWCC-19 with 50.0% while other genotypes had seed viability of less than 50.0% but NSWCC-24 gave lowest values of 24.0%. Seeds of NSWCC-19 and NSWCC-34c treated with ginger fruit powder recorded highest viability of 55.0% followed by NSWCC with 50% while other genotypes had less than 50% viability but NSWCC-29b had the least of 15.0%. Bleaching treatment recorded highest values of viability from NSWCC-34 with 76% followed by NSWCC-19 with 53% while NSWCC-18b had the least value of 23% and aspirin tablet powders treated seeds of NSWCC-19 and NSWCC-34 consistently recorded highest values of 44 and 41%, respectively while NSWCC-18b had the lowest value of 12%.

Table 5: Effect of seed enhancement material on seed viability of ten pigeon pea genotypes at 240 days of storage

Genotype	Scent leaf powder	Red chili pepper fruit	Ginger fruit powder	Bleaching powder	Aspirin powder	No treatment
NSWCC-18	66^{b}	72^{a}	61^{b}	69^{b}	69^{b}	63^{b}
NSWCC-18b	44^{f}	42^{d}	45^{e}	44^{e}	44^{f}	42^{f}
NSWCC-19	71^{a}	73^{a}	76^{a}	70^{b}	73^{a}	70^{a}
NSWCC-28	58^{c}	54^{b}	57^{c}	55^{c}	56^{d}	52^{d}
NSWCC-29b	42^{f}	40^{e}	41^{f}	39^{f}	39^{g}	39^{g}
NSWCC-32	68^{b}	55^{b}	64^{b}	62^{b}	60^{c}	61^{c}
NSWCC-34	58^{c}	53^{b}	59^{c}	60^{b}	58^{c}	42^{f}
NSWCC-34c	72^{a}	75^{a}	73^{a}	75^{a}	75^{a}	66^{a}
NSWCC-34b	47^{e}	48^{c}	46^{d}	45^{e}	50^{e}	48^{d}
NSWCC-35	53^{d}	48^{c}	49^{d}	49^{e}	49^{e}	45^{e}
S.E	1.64					

Mean followed by the same alphabet along same column are not significantly different from one another at 5% probability

4. DISCUSSION

The ten pigeon pea genotypes studied showed significant differences in seed viability due to genetic differences in their make-up. Efficacy of the seed enhancement treatments on the seed quality traits evaluated was dependent on genotype and storage duration. This summarily indicated that differences in seed treatments and genotype were responsible for variation recorded during storage in the seed quality traits considered. Also, seed enhancement using different organic and inorganic materials can significantly improve pigeon pea performance in storage by increasing seed germination and its viability. The result of this study further corroborated the earlier reports of Adebisi et al., [16], Huang *et al.,* [17], and Sachchida *et al.,* [18] respectively, that seeds treated with organic and inorganic treatments recorded significant improvements over untreated control in terms of viability emergence and vigor values. Aspirin tablet powders and Red chili fruit had better performance on seed viability and vigor of pigeon pea than other treatments. Thus, seed enhancement treatment such as red chili fruit powder was as effective as aspirin tablet powder (inorganic) in improving storability of pigeon pea seeds evaluated. The two treatments maintained 70% seed viability even after 360 day of storage. According to Divij et al., [14]; Huang et al., [17]; Sachchida et al [18]; Albert, [19]; they all reported the efficacy of organic and inorganic in controlling free radical reactions as anti-oxidants and anti-oxidant synergist in pigeon pea. Brand *et al,* [20], reported capsicin, been the most important active constituent of red chili fruit, is an outstanding inhibitor of lipid peroxidation while Linalool and gingerol, as most active ingredient in scent leaf and ginger powder, respectively as inhibitors of lipid peroxidation.

Sequel to the above, these active ingredients could have contributed to the vigour and viability maintenance of stored pigeon pea seeds. A cursor look at the research showed that, a sharp declination was observed in seed viability across all treatments, irrespective of pre-storage treatment used and became pronounced as from 240 days of storage. Higher seed viability was maintained at 0 to 120 days of storage and a sharp decline was observed with prolonged storage period. The sharp decline could be due to increase in the deteriorative process which were enhanced by the higher temperature (28.8°C) and relative humidity (61%) of the natural storage condition used in the study under ambient storage conditions.

Table 6: Effect of seed enhancement material on seed viability of ten pigeon pea genotypes at 360 days of storage

Genotype	Scent leaf powder	Red chili pepper fruit	Ginger fruit powder	Bleaching powder	Aspirin powder	No treatment
NSWCC-18	42^c	48^d	50^b	42^d	47^c	41^b
NSWCC-18b	29^e	24^f	22^f	23h	24^f	12^f
NSWCC-19	43^c	50^c	55^a	48^c	56^b	44^a
NSWCC-28	40^c	41^d	36^d	34^f	40^e	27^d
NSWCC-29b	21^f	24^f	15^g	12^i	17^h	13^f
NSWCC-32	40^c	41^d	40^c	37^e	44^d	38^c
NSWCC-34	31^d	36^e	31^d	71^a	76^a	41^b
NSWCC-34c	65^a	72^a	55^a	53^c	46^c	40^b
NSWCC-34b	26^e	27^f	24^f	24^h	18^h	21^e
NSWCC-35	29^e	40^d	24^f	28^g	20^g	20^e
S.E	1.63					

5. CONCLUSION

The result of this study showed that improving the seed health of pigeon and its longevity by seed enhancement with organic and inorganic materials before storage will invariably extends seed storage life and improves seed physiological quality under ambient seed storage condition. Aspirin tablet powders and Red chili fruit had better viability and vigor performance on pigeon pea seeds all through the storage period than other treatments. Since the seed storage enhancement materials used for this study, are cheap, affordable and environment friendly Thus, aspirin tablet powders and red chili fruit are recommended for use by small and medium scale seed dealers and farmers especially where modified seed conditioning of pigeon pea seeds are far beyond reach and unaffordable.

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